# An Investigation of the Impact of Drainage Activities on Judges Creek and Little Lake

BRUCE COUNTY
TOWNSHIP OF EASTNOR
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Ministry of the Environment
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# An Investigation of the Impact of Drainage Activities on Judges Creek and Little Lake

Bruce County
Township of Eastnor

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## BACKGROUND

In July and August of 1980, the Ministry of the Environment received complaints about poor water quality in the small lake, known locally as "Little Lake", located near the mouth of Judges Creek. The complainants suggested that recent agricultural drainage works on Judges Creek had been primarily responsible for the degraded quality of Little Lake.

## INVESTIGATION

The investigation by staff of the Ministry of Environment's Southwestern Region included the following:

A) review of complaints received
B) review of drainage activities
C) field investigation and sampling
D) consideration of climatic factors
E) review of land use activities on watershed
F) securing views on agricultural practices and/or water quality changes from complainants, local conservation officer, agricultural representative, Township clerk and drainage engineer
G) cost-benefit review

A) Complaints Received

The verbal and written complaints received clearly outlined legitimate concerns, and came from people who had known Little Lake for a number of years. The concerns related to excessive turbidity (see pictures 1 and 2), bacterial contamination and deterioration of the fishery in Judges Creek and Little Lake. Individuals expressed the need for positive action to prevent the continued discharge of solids from Judges Creek to Little Lake and Barrow Bay.

B) Drainage Activities

Drainage activities that have taken place on the watershed are outlined in a January 24, 1975 drainage report of E. H. Uderstadt Inc., to the Township of Eastnor. The creek was initially dredged out in 1901. During several years subsequent to 1901 (e.g. 1918, 1946, 1950's & later), various new branches of Judges Creek were ditched, and there was some repair and improvement work on the original drain. In the 1975 report of Uderstadt, it was concluded that even with the previous drainage activities, there were still flooding problems on the watershed, and that a major dredging and clean-out operation was required. This major project called for rock blasting near the mouth of Judges Creek to lower the grade line in the channel. The 1975 drainage proposal of Uderstadt was initiated as a result of a petition from five farmers on the watershed. The project commenced in 1975 and extended into 1976 and 1977 when the work was completed. Clean-out of a lateral drain known as the Dawson-Hewton drain was accomplished in 1979. A mutual agreement drain was constructed by two landowners on a tributary of Judges Creek in 1980. Picture 6 (page 8) which was taken at Lot 20, Concession 5 of the Township of Eastnor, illustrates this drain. An estimated 350 acres of the 19,000-acre watershed have been tile drained by local landowners (personal communication with the Clerk of the Township of Eastnor).

Picture 1. Illustrating turbidity of Little Lake, in contrast to the clear waters of Georgian Bay.

Picture 2. Illustrating turbid waters of Little Lake draining into Georgian Bay.

C) Field Investigation

Observations were made and/or samples collected from Judges Creek by Ministry staff on August 5, August 7 and August 21, 1980.

Specific observations were made at a number of locations on the watershed on August 7, 1980. Visual observations were recorded, water temperatures were taken at nine of these locations, and samples for chemical analyses were collected at three locations. Figure 1 illustrates the locations of the observation and sampling points.

The water in Judges Creek was observed to be heavily laden with solids at all locations checked, with the exception of areas near the Eastnor-Albemarle townline. The stream had been dredged by dragline to depths of 10 feet, involving the removal of 1 to 2 feet of sediment from the stream bottom. Soil on the ditch bottom and sides consisted of clay which was eroding badly in a number of areas. The banks of the ditch had been steeply cut and in a number of locations were noted to be in an erodable condition.

The following comments summarize some of the key observations of the August 7 watershed inspection and are supported by pictures following which illustrate some of the visual observations.

At Station 1 the dredging cut through a wetland. The water was observed to be flowing fast and clear at a temperature of 15°C. Owing to soil type and land use at this location bank erosion was minimal.

At Station 2 the stream had become very turbid resulting in siltation of the ditch bottom. Stream bank cover was not present and the water had warmed to 18.5°C. Also, cattle had clear access to the stream at this station. The banks were not stable at this location, resulting in slumping and considerable erosion.

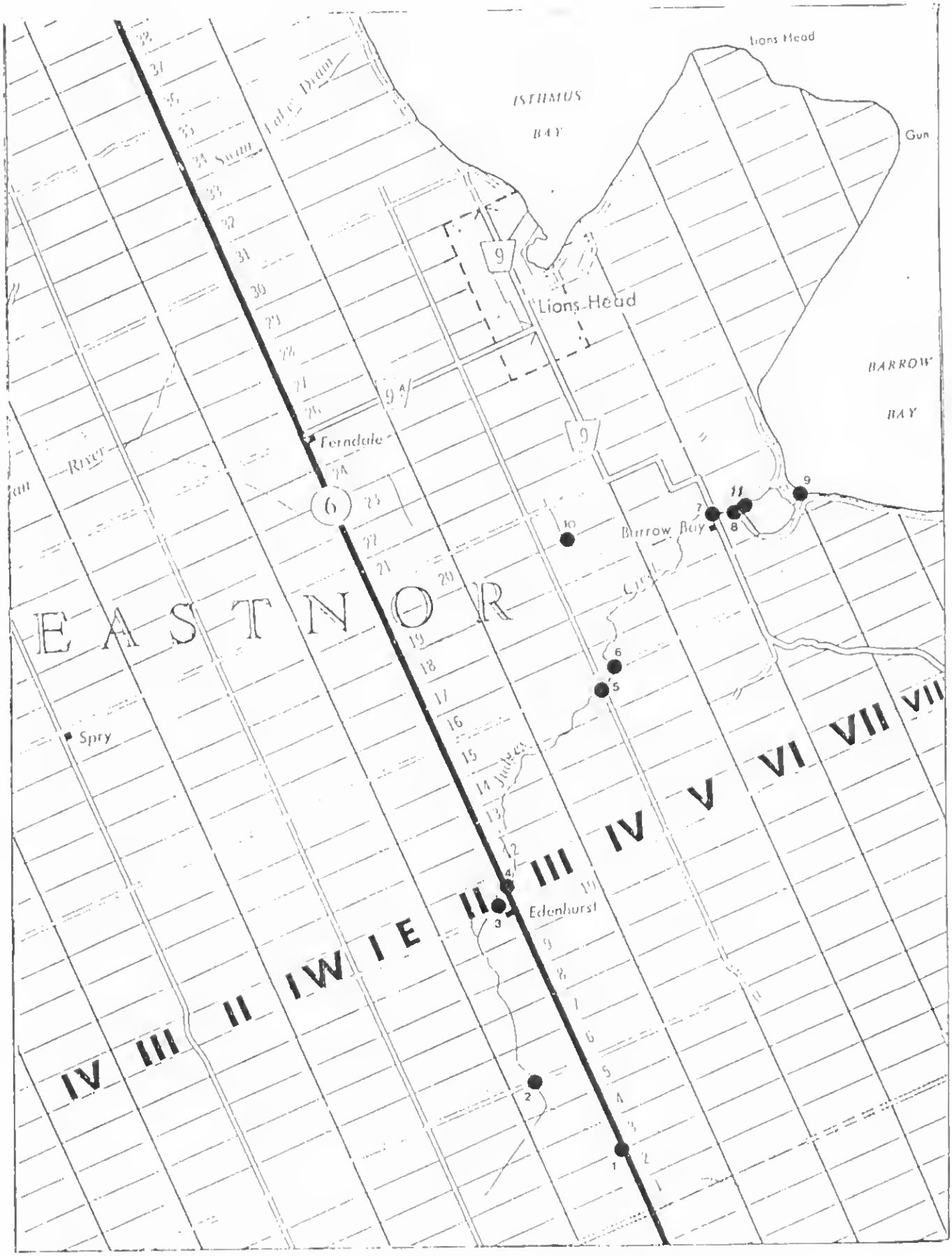



Figure 1. Station locations sampled August 7, 1980.

The lands adjacent to Station 3 were generally being used for crop production. Turbidity was very high at this location resulting from a combination of unstable eroding stream banks and erosion from adjacent corn fields. The severe bank erosion was reflected by the fence posts falling into the Creek. There was much the same type of land condition at Station 4 with the adjacent lands being used for crop production. The water had warmed to 22°C through this reach. A clear fast-flowing tributary enters Judges Creek between stations 4 and 5 and the Creek temperature from there to the mouth was 20°C.

Despite good grass cover and bushes at Station 5, probably attributable to a lack of grazing by cattle, the water remained turbid and the stream bottom was still heavily silted.

At Station 6 the Creek once again flowed through pasture where the cattle had complete access and once again the trampled banks were severely eroded (Picture 3). The stream was very turbid and the stream bottom was very heavily silted.

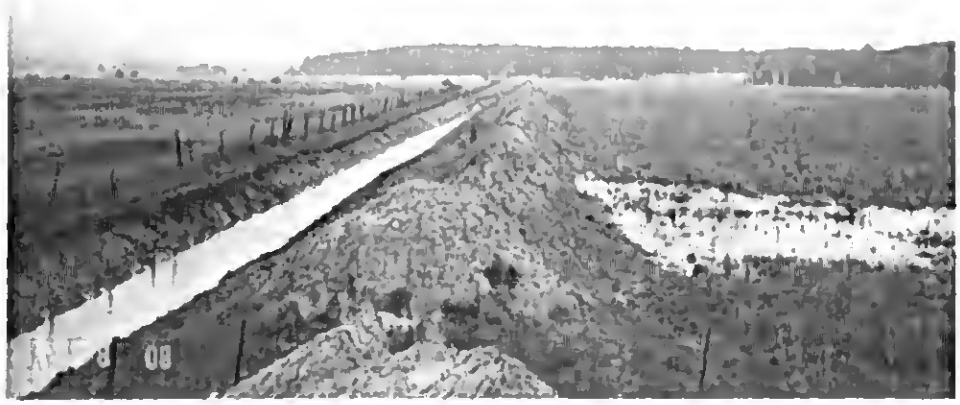
Judges Creek flows over the edge of the escarpment at Station 7 where a channel had been blasted out of the bedrock to permit faster drainage. Rock from this widening and deepening project was still lying beside the stream (picture 4). The water in this area was a very turbid brown colour. The filamentous alga, Cladophora, was common on the limestone steps and blocks which the Creek must flow over to reach the small lake at the bottom of the escarpment.

At Station 8 the Creek bottom is cobble and rock and was heavily silted. The water was a turbid brown colour (picture 5). A plume of turbid water was visible extending into the lake and along the north shore.

Picture 3. Illustrates free cattle access and denuded stream banks resulting in slumping of stream banks, erosion and turbidity.

Picture 4. Illustrates large pieces of limestone bedrock from blasting of the streambed.

Picture 5. The mouth of Judges Creek showing turbidity.



Picture 6. Recently ditched tributary showing steep cut, lack of bank vegetation and erosion of dredge spoils not yet levelled.

At the outlet of Little Lake (Station 9) to Georgian Bay, the turbid waters could be easily seen mixing with the clearer waters of Georgian Bay.

Station 10 was located on a newly constructed drainage ditch (picture 6). The ditch has steep denuded banks and the excavated material was not levelled back, creating an additional source of turbidity for Judges Creek.

The water in Little Lake (Station 11) was very turbid and a noticeable cloudy plume of solids was evident which spread approximately 75 feet out from the point where Judges Creek discharged to the lake. From an aesthetic viewpoint, and in light of the objectives for swimming and bathing use of water, page 40, MOE Water Management the water in Little Lake did not appear suitable for swimming at any location.

Table 1 outlines the chemical and bacteriological data obtained during the August 5 and 7 surveys and Table 2 indicates the desirable water quality values for pertinent parameters referenced in Table 1. Reference to the Table indicates the high levels of turbidity or suspended solids, total phosphorus and bacterial organisms that characterized Judges Creek during these field investigations. These elevated figures substantially reflect the impact of current agricultural practices throughout the basin, including the effects of recent dredging activities in accelerating the erosion process along the watercourse.

The results of chemical water analyses indicate concentrations of phosphorus and total nitrogen in Judges Creek, Little Lake and the channel leading to Barrow Bay which may promote accelerated growth of algae and aquatic plants. Excessive growths of aquatic plants were not observed at any location during the investigation, presumably because the turbid conditions at the time would inhibit light penetration and thus curb plant growths. It is noteworthy that a "bloom" of algae was investigated at Little Lake during the summer of 1976.

Table 1

August 5, 1980 Chemical Results (mg/l except for pH) and turbidity

| Station Number | $BOD_5$ | SOLIDS | | NITROGEN AS N | | | | PHOSPHORUS AS P | | pH | Chloride as Cl |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Total | Suspended | Free Ammonia | Total Kjeldahl | Nitrite | Nitrate | Total | Diss. Reactive | | |
| 8 | 0.6 | 405.6 | 69.9 | 0.015 | 0.66 | 0.009 | 0.30 | 0.092 | 0.017 | 8.28 | 3.5 |
| 9 | 0.5 | 292.2 | 3.5 | 0.045 | 0.67 | 0.007 | 0.12 | 0.024 | 0.004 | 8.44 | 4.5 |
| 11 | 0.6 | 330.3 | 7.9 | 0.075 | 0.81 | 0.008 | 0.12 | 0.040 | 0.008 | 8.36 | 4.0 |

Aug. 7, 1980 Chemical Results (mg/l except for pH)

| Station Number | Free Ammonia | Total Kjeldahl | Nitrite | Nitrate | Total Phosphorus | Dissolved Reactive P | pH | Turbidity (f.t.u.'s) | Calculated Hardness | Chloride as Cl |
|---|---|---|---|---|---|---|---|---|---|---|
| 8 | 0.025 | 0.70 | 0.011 | 0.32 | 0.106 | 0.011 | 8.24 | 31.0 | 281 | 3.5 |
| 6 | 0.020 | 0.64 | 0.008 | 0.32 | 0.106 | 0.007 | 8.04 | 35.0 | 186 | 2.0 |
| 4 | 0.025 | 1.00 | 0.006 | 0.22 | 0.156 | 0.019 | 8.03 | 15.0 | 281 | 2.0 |

Notation - Stations 4, 6, 8 and 9 were located on the stream. Station 11 was located in Little Lake, about 50 feet from the entrance of Judges Creek.

Table 1 - continued

August 5, 1980 Bacteriological Results (organisms/100 ml)

| Station Number | Total Coliforms | Background | Fecal Coliforms | Fecal Streptococci |
|---|---|---|---|---|
| 8 | 2,600 | 14,100 | 1,180 | 110 |
| 9 | A20 | 1,210 | A20 | L10 |
| 11 | A20 | 2,510 | A20 | L10 |

August 7, 1980 Bacteriological Results (organisms/100 ml)

| Station Number | Total Coliforms | Background | Fecal Coliforms | Fecal Streptococci |
|---|---|---|---|---|
| 8 | 6,500 | | 2,100 | 720 |
| 6 | G6,700 | | 3,200 | 1,100 |
| 4 | G7,300 | | 2,800 | 450 |

G = Greater Than

A = Approximately

Table 2

Pertinent Desirable Water Quality Values for Streams or Lakes for Various Water Uses
Chemical Data (mg/l except for pH)

| | $BOD_5$ | SUSPENDED SOLIDS | NITROGEN AS N | | | | TOTAL PHOSPHORUS | pH | TURBIDITY |
|---|---|---|---|---|---|---|---|---|---|
| | | | Free Ammonia | Total Kjeldahl | Nitrite | Nitrate | | | |
| 1) Drinking water | | | | | | 10 | | | |
| 2) Livestock watering | | | | | 10 | | | | |
| 3) Aquatic life and recreation | no reduction of dissolved oxygen below 5 mg/l (cold water species) or 4 mg/l (warm water species) $BOD_5$ values <5 mg/l would generally be acceptable | Free from objectionable turbidity or deposits | Up to .3 | | | | .03 | 6.5-8.5 | Free from objectionable turbidity |

Bacteriological Data (organisms/100 ml)

| | Total Coliforms | Fecal Coliforms | Fecal Streptococcus |
|---|---|---|---|
| 5) Swimming, bathing | 1000 | 100 | no fixed value |

Values for drinking water, livestock watering, aquatic life and swimming are extracted from the MOE publication - Water Management, November, 197B.

D) Climatic Factors

Abnormally heavy rains during this past summer resulted in excessive runoff and soil erosion. The significance of this factor can best be appreciated by a consideration of the cumulative rainfall total recorded at the Wiarton meteorological station for the month of July, 1980. A total of 200.7 mm (7.9 inches) of rainfall was experienced during this month, compared to a long-term average of 68.1 mm (2.7 inches) for July based on the period of record 1941-70.

E) Land Use Activities

The watershed is primarily pasture land and forest, with some lands used for hay and limited grain and corn production. The trampling of stream banks by cattle, the failure to provide flatter slopes and vegetative cover on ditch banks during drainage projects, improper handling of dredge spoils and lack of permanent vegetative buffers to separate cultivated lands from the stream were noted to be significant land use factors affecting the quality of Judges Creek during the August 5 and August 7 investigations.

F) Evidence of Water Quality Change

It was concluded, after telephone conversations with persons conversant with the area, that Little Lake has been affected by turbidity for a number of decades. However, it would appear that there has been an acceleration of the deterioration of Little Lake during recent years as a result of the agricultural activities throughout the watershed. The lake is no doubt more turbid now than it was several decades ago and bacterial levels have likely increased with increases in numbers of cattle sustained on an open-pasture basis.

G) Cost-Benefit Review

Based on conversations with the local conservation officer, dredging activities on the watershed have resulted in a number of adverse impacts on the Judges Creek drainage basin. These adverse impacts include:

a) reduced trout fishery
b) reduced deer yards
c) reduced wetland habitat for a variety of birds and animals

The increased turbidity associated with the dredging activity contributed to reducing recreational quality for shoreline residents who occupy the 100± dwellings on Little Lake. A rough estimate of the real estate investments by property owners on Little Lake is in the order of 3-4 million dollars.

As mentioned previously in the report, the major drainage works resulting from the 1975 engineering report was initiated by five of the 100+ farmers within the watershed. The 1975 engineer's report listed 25 landowners as benefitting from the proposed works. Costs associated with the total works (A drain + B Drain) as identified in the 1975 report amounted to $190,000.

Considering the fact that the major portion of the cleared drainage area is permanent pasture supporting beef cattle production and that a minimal area is tile drained and/or in cattle production, it is felt that the agricultural benefits to be derived from the 1975 drainage project should have been carefully considered in relation to the potential disbenefits to result. Further, the Ministry of Natural Resources, which was listed as a benefitting agency and properly so under the terms of the Drainage Act, felt

strongly that the works would impair their lands (of a wetlands character) and seriously undermine fish and wildlife values on their property. A representative of that Ministry presented a forceful appeal at a meeting with township officials that the project not be allowed to proceed but by this time the contract had been let and the Ministry was not prepared to meet costs to suspend the operation. When the project commenced it included the Ministry's property which is situated at the headwater source of Judges Creek, which action would have tended to aggravate the spring flooding conditions that the drainage project was designed to remedy. In its natural condition, this swampy area with its natural springs would have acted as a stabilizing factor to limit flooding by reducing snow build-up in the winter (i.e. warmer temperatures and related melting of snow) and by retarding the spring runoff from that area because of damming activity by beavers.

Of utmost significance to this investigation, no consideration was given to the negative impacts on the recreational and aesthetic quality of Little Lake that would occur both from the dredging operation itself and the failure to incorporate ditch bank stabilization and other environmental safeguards into the drainage project.

## CONCLUSIONS AND SUMMARY

Little Lake has been a turbid body of water for several decades but has become increasingly turbid with time. The basic reason for this turbidity is that the lake is located at the bottom end of a watershed that drains clay soils. Because of the small size of the lake relative to the size of the drainage basin, the entire lake has become affected and the turbidity extends well into Barrow Bay during high runoff conditions.

Excessive discolouration of the lake has been the rule following spring thaws and related flooding conditions. It is felt that these occasions have not engendered marked public complaints since limited numbers of people frequent their cottages at this time of year and swimming and other water-oriented activitied are not engaged in until the water warms up, by which time much of the silt has settled to the bottom of the lake.

In the summer of 1980, with the cottage season at its peak, abnormally heavy rainfall produced extreme erosion throughout the Judges Creek watershed and substantial quantities of silt were transported down to Little Lake.

Existing agricultural practices fail to prevent cattle from gaining access to the stream and trampling of the stream banks results. There is no doubt that this is a major factor leading to increased silt loads in Judges Creek and one that must be dealt with to make any remedial program effective. Also, lack of a permanently vegetated buffer zone between the stream and cultivated areas has contributed to the impact of erosion and its effect on deteriorating water quality conditions. Further aggravation of erosional effects has resulted from dredging activities that, similar to most other drainage projects throughout the Province, have failed to provide proper slopes, encourage early re-vegetation of ditch banks and, in at least one drainage project, proper disposition of dredge spoils.

The manner in which a major dredging of Judges Creek was carried out based on a 1975 engineering report, in addition to contributing to the turbidity of Little Lake, also had marked negative effects on high quality fishery resources in the upper end of the watershed and on significant wildlife values in the same area. Considering the assigned agricultural benefits in relation to the actual

dollar costs and negative environmental effects associated with this project, it would have been desirable to have an overall cost-benefit evaluation carried out prior to the inception of the project.

From observations of the existing conditions, it is evident that large quantities of soil are being washed into Judges Creek, Little Lake and to a lesser extent Barrow Bay. The aesthetic and recreational quality of Little Lake will continue to deterioriate as this soil erosion process continues. Deterioration of the quality of water in Barrow Bay near the discharge area of the channel from Little Lake may also become more evident over time as the carry-over of solids from Little Lake to Barrow Bay increases.

The bacterial problem in Little Lake cannot be accurately assessed without an intensive investigation. The livestock population within the watershed is a potential source of bacteria and faulty sub-surface sewage disposal systems at cottages around the lake might also be implicated.

## RECOMMENDATIONS

1. The Township of Eastnor should minimize further detrimental impacts from stream erosion along Judges Creek by undertaking a remedial program to provide proper side slopes, stabilization of ditch banks through seeding and use of rip-rap or other bank protection measures, where warranted. Support should be afforded by the Ministry of Environment and possibly the Ministry of Agriculture and Food through the provision of Experience 81 students to inventory those sites where remedial measures are required, as a basis for subsequent action by the Township.

2. The Ministry of the Environment and the Ministry of Agriculture and Food should co-operate in a program designed to encourage landowners along Judges Creek to take advantage of funds available under the Farm Productivity Incentive Program of the Ministry of Agriculture and Food in order to minimize erosion problems created by cattle access, improper tile outlets (if any) and absence of adequate vegetative buffers where the stream traverses cultivated lands.

3. An investigation should be mounted under the auspices of the Ministry of Environment to assess the sources of bacterial contamination to Judges Creek and to further assess bacterial conditions in Little Lake. Recommendations should be advanced for eliminating those sources which are considered to represent a hazard to human health or to impact adversely on other water uses.

In addition, the problems evident in the situation that has developed on Judges Creek point up recommendations that are worthy of consideration in relation to the present provisions and administration of The Drainage Act. Other water use conflict situations have developed as a result of drainage activities within the Southwestern Region during the past year and it is felt that future conflicting situations could be minimized by adoption of the following:

A. Similar to criteria for identifying significant wetlands areas, criteria for identifying watercourses (including those presently classified as drains under The Drainage Act) should be established to indicate those that should be subject to an all-factors evaluation of cost effectiveness and an environmental appraisal prior to any drainage work being undertaken. These criteria should be developed co-operatively by

staff of the Ministry of Agriculture and Food, the Ministry of Natural Resources and the Ministry of the Environment. Any such reviews or appraisals should be assessed by the Ministry of the Environment, the Ministry of Natural Resources, the Ministry of Agriculture and Food and the local Conservation Authority before approval for a particular project is granted.

B. Present drainage practices need to be upgraded to minimize adverse impacts both on the public water resource and the legitimate interest of downstream users. It is suggested that the recent steps taken by providing environmental protection guidelines in the manual "Design and Construction Guidelines for Work Under the Drainage Act, 1975" be broadened to include an educational program. This program should be directed at members of municipal councils, drainage superintendents, drainage commissioners, and any others involved in drainage activities to create a greater awareness of and concern for the environmental implications of drainage practices.

C. It is recommended that the provision of grants by the Province for drainage projects should be dependent on the inclusion of essential environmental protection measures, both to safeguard the provincial interest in good water quality and to optimize water use potential.

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